Center Innovation Fund: SSC CIF

A Detailed Assessment for the Potential use of Waste Hydrogen Gas at Stennis Space Center

Completed Technology Project (2012 - 2012)

Project Introduction

Stennis Space Center (SSC) is NASA's primary liquid rocket engine test facility. As such, large amounts of liquid hydrogen are used as a rocket propellant. This liquid hydrogen is stored in insulated vessels throughout the center where significant portions of the propellant boils off due to heat leak. The resulting boiloff hydrogen gas is currently considered a waste product and is subsequently burned in flare stacks for safety purposes. Because waste hydrogen is a significant cost loss to the facility, SSC is interested in identifying a method of utilizing the boiloff hydrogen for electrical power generation rather than simply flaring it off as an expensive waste gas. This power could then be used on-site to offset the cost of purchasing commercially-generated electricity.

The objective of this study was to identify and estimate the cost of one or more approaches of utilizing waste hydrogen for power generation. To simplify the scope of the problem, this study was limited to the boiloff source of the run tank at one test stand which consistently produces 500 gallons of hydrogen gas every day. This study used the results of several previous studies that also examined different ways of allaying the waste hydrogen problem. Using literature from these previous efforts as a starting point, a market review was conducted to find potential systems of hydrogen-fueled energy generation that are currently available. Candidate systems were considered based upon their compatibility with requirements dictated by the test stand and related infrastructure. These requirements were developed from technical data and drawings and supplemented with knowledge gained during a site visit to the test stand.

The market review revealed only a single viable option: a hydrogen-fueled 4.9-L reciprocating engine and generator set.

A high-level design of the supporting infrastructure was carried out in order to conduct a reasonably accurate cost analysis once a prime mover and generator system was selected. Gas and water piping systems were developed, electrical equipment needs were identified, and a general site layout determined. Cost estimates were then made for materials, equipment, installation labor, maintenance and prime contractor expenses.

With the performance of the power generation system, capital and variable expenditures known, life cycle cost analysis metrics were calculated. Impacts of the developed system on the environment were also assessed.

Anticipated Benefits

The results of this study revealed that benefits to NASA funded missions would be limited due to the high investment cost of purchasing and installing the generator/engine set and related infrastructure, the low electrical output of the generator/engine set compared to that used by the test stand, and

Logo for the Office of Chief Technologist

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Stennis Space Center (SSC)

Responsible Program:

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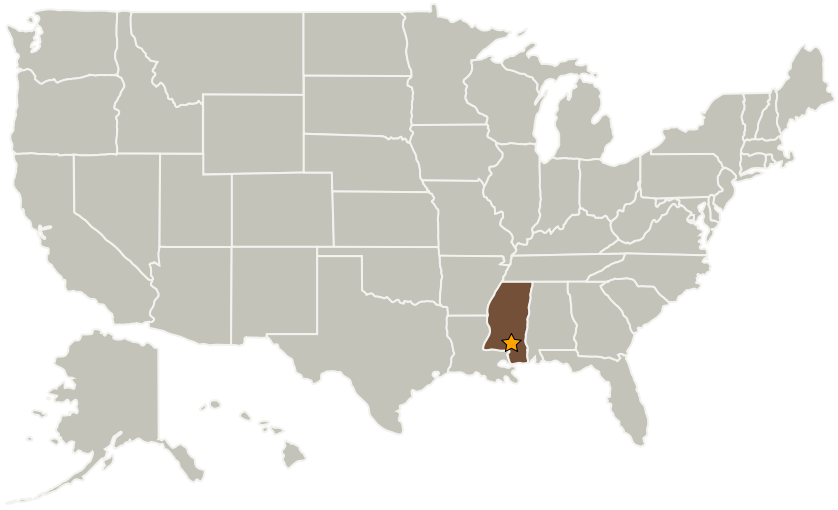
uncertain future costs of electricity.

Information from this project regarding the capture and conversion of excess hydrogen into another form of usable energy could benefit SSC and other NASA centers that may boiloff excess hydrogen if they are capable of funding the initial investment and have a power consumption rate less than or equal to the power generated.

The benefits to the commercial space industry are similar to anticipated possible benefits to other government agencies, where waste hydrogen is an issue that must be addressed.

Information from this project regarding the capture and conversion of excess hydrogen into another form of usable energy can benefit other federal agencies that may have waste hydrogen, and must meet federal mandates to reduce consumption.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Stennis Space Center(SSC)	Lead Organization	NASA Center	Stennis Space Center, Mississippi

Project Management

Program Director:
Michael R Lapointe

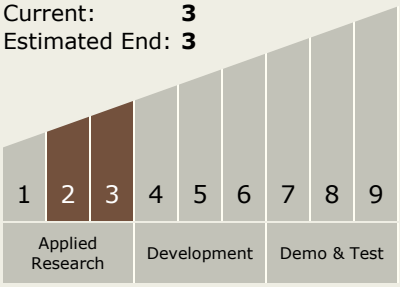
Program Manager:
Ramona E Travis

Project Manager:
Melissa P Ferguson

Principal Investigator:
Melissa P Ferguson

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.2 Earth Storable

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Primary U.S. Work Locations
Mississippi

Images

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(https://techport.nasa.gov/image/3967)